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## Observations and Numerical Simulations of the Effects of the Gamma Ray Burst 221009A on the Lower Ionosphere

In this contribution we investigated the impact of a powerful gamma ray burst (GRB) that occurred on October 9 2022, on the Earth's environment using a very low frequency receiver (VLF) to probe the lower ionospheric region (the D region). In addition to the VLF data analysis, we employed numerical simulation through the Long Wavelength Propagation Capability code (LWPC) to derive the increase in the D-region electron density. Our results revealed discernible perturbations in amplitude and phase across all transmitter paths (NAA, DHO, ICV, and NSC) to the Algiers receiver persisting for 40 minutes. At the maximum of the signal perturbation, the LWPC simulation results showed a decrease in the mean new reference height  $h'_{\text{p}}$  from 74 km to 65.71 km, along with an increase in the sharpness factor  $\beta$  from 0.3 km<sup>-1</sup> to 0.4875 km<sup>-1</sup>. Under these new conditions, the electron density increased from its ambient value (216.10 cm<sup>-3</sup> to 33.7 10<sup>3</sup> cm<sup>-3</sup>

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